

First confirmed record and first breeding record of Indian Spotted Eagle *Aquila hastata* in Indochina

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Received 9 July 2010

Indian Spotted Eagle *Aquila hastata* was long treated as a subspecies of Lesser Spotted Eagle *A. pomarina* (e.g. Grimmett *et al.* 1998). However, Parry *et al.* (2002) made the now widely accepted case for recognising resident populations of *A. pomarina* in the Indian subcontinent specifically, *A. hastata*, which was subsequently corroborated by a phylogenetic analysis based on mitochondrial DNA sequences (Väli 2006).

To date only Greater Spotted Eagle *A. clanga* has been confirmed in Cambodia, but *A. hastata* has been suspected to occur. Greater Spotted Eagle breeds from Eastern Europe to eastern Russia and is a regular winter visitor to Cambodia (Thomas & Poole 2003, Robson 2008). Birds similar to Indian Spotted Eagle were seen and photographed in Cambodia in 2003 (Goes & Davidson 2003) and on several occasions since (J. C. Eames, J. Eaton, J. Pilgrim, P. Round, H. Wright *et al.* pers. comm.), but due in part to doubt over the field identification, none of the observations has been published in a scientific journal.

In mid-June 2009, a darkish eagle in juvenile plumage with fully feathered tarsi was found, with clipped wing feathers, in Thnal village, Prasat Balang District, Kampong Thom Province, Cambodia (12°59'10"N, 104°56'47"E). According to the villagers who kept the eagle, it had been collected as a chick from a nest in deciduous forest nearby, in May 2008. We immediately identified the bird as a 'spotted eagle' as it had rounded nostrils and extensive whitish spotting on the crown, scapulars and wing-coverts, but the specific identity was harder to establish due to the morphological similarities between spotted eagles. The bird was handed to officials of the Forestry Administration and subsequently transferred to the Angkor Centre for Conservation of Biodiversity (a wildlife rescue centre). For species confirmation, morphological features were examined and DNA testing undertaken (the latter also for sex determination). The bird was not suitable for release and at the time of writing remains alive at the centre.

Methods

Plumage features were examined and selected biometrics of the captive bird were taken in August 2010 using callipers (for culmen chord from tip of bill to skull, mandibular symphysis length, gape length, and gape breadth including the fleshy flange) and a zero-stop wing rule (for maximum tarso-metatarsus length). These features were compared with Forsman (1991), Parry *et al.* (2002) and Rasmussen & Anderton (2005).

DNA was extracted from a sample of breast feathers, using QIA Quick DNEasy Kit (Qiagen Inc., Hilden, Germany) according to the manufacturer's instructions, but with 30 µl DTT added to the initial incubation step. Amplification and sequencing followed the protocols described in Olsson *et al.* (2005). Reference sequences for the following eight eagle taxa were obtained from GenBank: *Aquila rapax vindhiana*, *A. [pomarina] pomarina*, *A. [p.] hastata*, *A. clanga*, *A. heliaca heliaca*, *A. nipalensis nipalensis*, *A. chrysaetos daphumes* and *Spizaetus cirrhatus* (= *Nisaeetus cirrhatus*). Sequences were aligned using MegAlign 4.03 in the DNASTar package (DNASTar Inc., Madison, WI, USA). We performed both an exhaustive search and bootstrapping in PAUP* (Swofford 2001). The settings for the parsimony bootstrap were

heuristic search strategy, 10,000 replicates, starting trees obtained by stepwise addition (random addition sequence, ten replicates), TBR branch swapping, MulTrees option not in effect (only one tree saved per replicate).

Results

Plumage.—Greater Spotted Eagle was excluded by the generally dull brown rather than blackish-brown or dark rufous-brown plumage both above and below, the pronounced dark-barred flight feathers, and the overall less pronounced pale spotting above (Forsman 1991, Rasmussen & Anderton 2005). The Cambodian bird showed all of the five plumage features listed by Parry *et al.* (2002) that distinguish juveniles of Indian Spotted Eagle from Lesser Spotted: no rufous nape patch; spots only on tips of upperwing-coverts, not on shafts; tertials pale brown with diffuse white tips; uppertail-coverts very pale brown with



Figure 1. Underside of the captive female Indian Spotted Eagle *A. hastata* in Cambodia. Note the dull brown rather than blackish-brown or dark rufous-brown plumage, and the pronounced dark-barred flight feathers below that distinguish it from juvenile Greater Spotted Eagle *A. clanga*. At the time (March 2010), the bird had already moulted most body feathers below (Markus Handschuh / Angkor Centre for Conservation of Biodiversity)

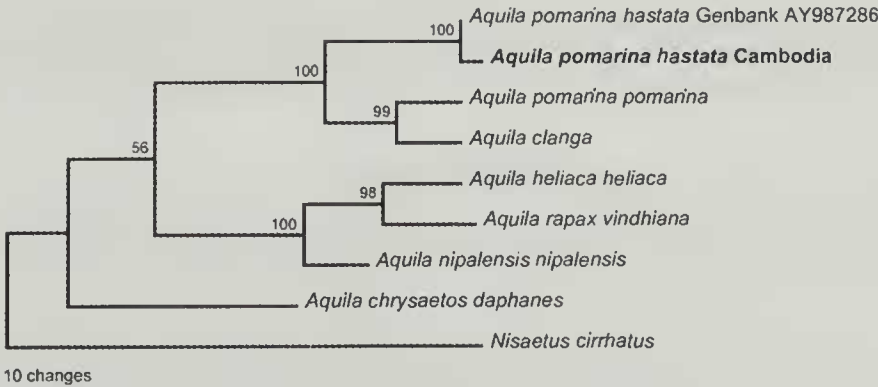


Figure 2. Phylogram of the most parsimonious tree. Bootstrap support values are given above the branches. All relevant nodes receive strong support.

white barring; and underparts pale yellowish brown with darker streaks. Fig. 1 illustrates some of these features.

Biometrics.—Table 1 shows selected biometrics of the Cambodian bird compared to museum specimens measured by Parry *et al.* (2002). Using DNA sexing, the sex was found to be female. Three of five measurements match the biometrics of specimens of Indian Spotted Eagle. However, three of five measurements fall outside the range for female Indian Spotted Eagle as follows. (1) Gape length was below the 95% confidence range for female Indian Spotted Eagle, but within the range for male Indian Spotted and outside the ranges for Lesser Spotted and Greater Spotted. (2) Gape breadth was above the ranges for all species, but is only 0.8 mm above the 95% confidence range given for female Indian Spotted Eagle; and (3) tarso-metatarsus length falls above the ranges given for Indian Spotted and Lesser Spotted, but within the 95% confidence range for Greater Spotted Eagle.

TABLE 1

Biometrics of the Cambodian spotted eagle compared with biometrics of museum specimens taken from Parry *et al.* (2002). All measurements are in mm. For the captive bird, callipers were used to measure culmen chord (from tip of bill to skull), mandibular symphysis length, gape length, and gape breadth (including the fleshy ‘lips’); tarso-metatarsus length was measured as maximum length using a zero-stop wing rule. Parry *et al.* (2002) did not present absolute minimum and maximum values or details of the measuring techniques used.

		95% confidence interval for measurements by Parry <i>et al.</i> (2002)					
	Captive female (this study)	Indian Spotted male	Indian Spotted female	Lesser Spotted male	Lesser Spotted female	Greater Spotted male	Greater Spotted female
Culmen chord	45.1	42.1–43.8	43.4–45.7	39.7–42.9	42.1–44.1	45.0–47.3	49.4–51.3
Mandibular symphysis length	14.4	13.0–13.7	13.7–14.7	14.4–15.8	15.4–16.4	15.6–16.7	17.1–18.0
Gape length	57.9	56.3–59.5	58.8–61.4	48.4–52.2	51.2–53.4	55.0–57.7	59.4–61.4
Gape breadth	49.5	45.2–47.0	46.2–48.7	35.2–38.6	36.3–38.4	39.5–42.1	42.0–43.9
Tarso-metatarsus length	105.0	93.9–98.0	94.2–99.5	90.5–97.7	93.8–98.4	101.8–107.2	103.5–107.5

Genetics.—For species confirmation, we obtained a contiguous 1,041 base pair portion of the cytochrome-*b* gene from the captive eagle. The aligned cytochrome-*b* sequences contain 1,038 characters, of which 105 (10%) are parsimony informative. The exhaustive search resulted in a single most parsimonious tree (Fig. 2), which is congruent with Helbig *et al.* (2005), Lerner & Mindell (2005) and Väli (2006). The sequence is most similar to the published sequence of *A. [p.] hastata* (specimen UMMZ 78272, male, collected on 1 May 1933 by W. N. Koelz at Bhadwar, Kangra District Himachal Pradesh, India) from which it differs by 0.3% (uncorrected *p*). This is clearly within the range of normal intraspecific variation. Differences between the GenBank reference sample for *hastata* and those of both *A. [p.] pomarina* and *A. clanga* were 4%. Differences between *A. [p.] pomarina* and *A. clanga* were 1.7%.

Discussion

On plumage and genetics, as well as several biometrics, in particular the striking bill morphology with an unusually broad gape, the Cambodian bird matches Indian Spotted Eagle more closely than any other species, making this the first confirmed record for Cambodia and Indochina. Differences were noted from published descriptions in respect of gape length and breadth, and tarso-metatarsus length. The longer tarsus and in particular the slightly broader gape, which included the fleshy flange in the Cambodian bird, are

probably explained by the well-documented post-mortem shrinkage in museum specimens (e.g. Winker 1993); all three biometric differences may also be due to individual variation and potential differences in measuring techniques. Parry *et al.* (2002) do not give absolute maximum and minimum values for these taxa, or details of how the measurements were taken. Review of a larger number of Cambodian individuals should be undertaken to look for potential subspecific differences, and this need is supported by unconfirmed reports from the field of consistent plumage differences between Cambodian and Indian populations. To complement this, the sequence of immature plumages of the captive bird is being recorded as it matures.

Indian Spotted Eagle is an uncommon and local resident in India and southern Nepal, with records from south-west and south Myanmar, which are thought perhaps to be of winter migrants (Rasmussen & Anderton 2005, Robson 2008). It is considered extinct in Bangladesh (Robson 2008). The Cambodian record reported here extends the breeding range by c.2,000 km. Indian Spotted Eagle should be sought in extensive tracts of open lowland deciduous dipterocarp forests in intervening areas of Myanmar and Thailand, and in southern Vietnam and southern Laos. A reassessment of specimens and photographs of *Aquila* eagles from these areas might also reveal previously overlooked records of Indian Spotted Eagle.

This record suggests that at least some, if not all, of the suspected Indian Spotted Eagles recorded in Cambodia by various observers since 2003 were probably correct. A detailed collaborative review of past records of *Aquila* eagles in Cambodia is underway, as is an analysis of plumage features of Indian Spotted Eagles in Cambodia and the field identification of this population. To facilitate this, MH would be grateful to receive previously unpublished records of *Aquila* eagles from Cambodia or adjacent areas. Reports of Indian Spotted Eagle have come from several localities in deciduous dipterocarp forest in Preah Vihear and Stung Treng provinces (J. Eames, J. Eaton, J. Pilgrim, P. Round, H. Wright *et al.* pers. comm.) and include displaying birds (P. Round pers. comm.), suggesting the presence of a significant breeding population of *A. hastata* in Cambodia. There are also records of Greater Spotted Eagle from the same areas and habitats, both historical (Delacour 1929) and recent (Goes & Davidson 2003, Robson 2008), indicating the need for great caution in identifying spotted eagles (and indeed any *Aquila* eagle) in Indochina.

Indian Spotted Eagle appears to occur at very low densities throughout its range and is largely restricted to lowland deciduous dipterocarp forests. The species is currently considered globally Vulnerable to extinction (BirdLife International 2010). Cambodia is one of the few countries in tropical Asia where large tracts of suitable forest remain, and significant opportunities for the conservation of this species may exist there. However, as elsewhere, land use is changing rapidly: for example, the nest site from where the Cambodian juvenile had been taken has since been deforested for a paper pulp plantation. Indian Spotted Eagle may occur regularly within some of Cambodia's protected areas and nest surveys are planned in areas from which convincing sight records are available.

Acknowledgements

We thank Bill Clark, Will Duckworth, James Eaton, Colin Poole, Pamela Rasmussen and Phil Round for comments. We also thank Duckworth, Eaton, Round, Jonathan Eames, Dave Gandy, Frédéric Goes, John Pilgrim, Edward Pollard, Hugo Rainey and Hugh Wright for their records and / or photographs.

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The type locality of the Olive Warbler (Peucedramidae)

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Received 13 August 2010

Lowery & Monroe (1968: 78) correctly stated that the original type locality (Mexique = Mexico) of *Sylvia taeniata* Du Bus, 1847 (now *Peucedramus taeniatus*) was restricted to San Cristóbal, Chiapas, by Brodkorb (1944). But, they added that Zimmer (1948a) had shown that the type probably came from San Pedro, Oaxaca. Perhaps they intended the latter statement to be accepted as a correction to Brodkorb’s designation, but it seems instead to have resulted in uncertainty and taxonomic confusion (Lowther & Nicedal 1997, Curson 2010). The two suggested type localities are on opposite sides of the Isthmus of Tehuantepec, which may (or may not) be the boundary of subspecific populations, one of which would be the nominate subspecies.

Hellmayr (1935: 360) may have been the first to restrict the type locality of *Sylvia taeniata* Du Bus, in the synonymy of *Peucedramus olivaceus* (Giraud, 1841), suggesting that ‘Mexique’ was ‘probably the state of Vera Cruz, where some of the other new Mexican birds described by Du Bus came from.’ Information in van Rossem (1942) shows that cannot be correct.

Van Rossem (1942) examined the type specimens of both *Cyanocorax unicolor* and *Sylvia taeniata* of Du Bus (1847) in the Brussels museum in 1939. Both specimens were collected by